1996 ANNUAL REPORT ISSUE

E2 energy efficiency

WINTER 1997 VOL 2 NO 1

Energy Centers ■ Dairy Designs ■ Green Pricing
Market Sleuths ■ Training Professionals ■ FY 96 Financial Summary

A PUBLICATION OF THE ENERGY CENTER OF WISCONSIN

Mission Statement

To sponsor and conduct

RESEARCH in efficient

use and management of **ENERGY,**

and to develop, demonstrate, and transfer

the **RESULTS** of that research

to Wisconsin's energy service

CONSUMERS and providers.

■ Research, develop, and demonstrate the efficient use of energy where cooperative efforts improve quality and value or offer opportunities that would be otherwise unavailable to individual participants. ■ Develop complete information on customers' use of energy and customers' preferences for Wisconsin planners, forecasters, implementors, and evaluators. ■ Act as an information clearinghouse for research, development, and demonstration issues and results that add value for Wisconsin customers. ■ Inform and educate Wisconsin customers, regulators, legislators, and providers about choices for meeting consumers' energy-service needs. ■ Encourage and support basic research that expands the underlying knowledge foundation for activities that promote the efficient use of energy. ■ Increase confidence and promote consensus regarding information used in planning and evaluation policies. ■ Promote expertise in appropriate principles, practices, and research methods among professionals, students, and other interested parties.

Cover

"Desperation"

This painting depicts anguished reaction to the loss of the energy utility infrastructure in Armenia following the breakup of the Soviet Union. A man and his son are cutting wood in winter, with the city of Yerevan looming in the background. They are ill-equipped for the task, and they are harvesting precious wood in a region where few trees remain. Indeed, many of the trees that once shaded the streets and parks in Yerevan have met such a fate. The people are driven by desperation, for the source of space heat in Yerevan, the district heating system, no longer operates, and until recently electricity flowed for scarcely an hour per day.

Mark Hanson purchased the painting at a Yerevan hotel in 1993. The artist's name is Varujan Shirinian, and his materials reflect the desperation of the woodcutters–the canvas is made from an old curtain stretched over a crude, cracked frame. It reminds us of how people feel when the systems they rely on fail to deliver, and how the result can lead people down an unsustainable path.

Energy Center of Wisconsin

E² energy efficiency

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"What part of 'save' don't you understand?"

–James Bryd
8th Grade
Grand Avenue School
Milwaukee, Wisconsin

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PRESIDENT'S NOTE

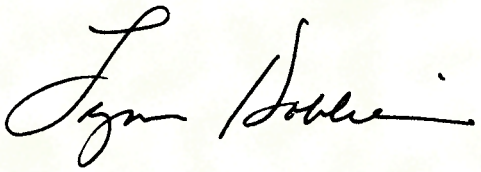
Lynn Hobbie
Board President

This is a time of questions. Looking at the many paths that Wisconsin's energy marketplace might take as utility restructuring progresses, people ask: Who will be providing public benefits—energy efficiency, environmental research, low-income services, alternative energy—as Wisconsin changes the fundamental ways it provides energy and related services? And how will the Energy Center of Wisconsin fit into this picture? Some even wonder if the Center will exist a few years down the road.

At this point the answers are unknowable. But this period of not knowing is a sign of the long and careful discussion necessary to bring forth solutions that will work in our complex energy marketplace. I am gratified to see so many groups—utilities, government, industry, public-interest groups, scientists, and others—making their contributions to the discussion.

Even if we don't know where the Center will be by the time the next annual report rolls around, this issue will show where it is today, and the potential it has for tomorrow. You'll learn a bit about the energy marketplace and the Center's efforts to understand it; see how other energy centers are coming together in this era of change; and even get a fascinating sneak peak into some of the most innovative high-efficiency technologies.

I hope the following pages will answer many of your questions about the information, services, and research that the Center provides; no doubt it will spark some new ones too. Keep asking—we will continue to find the solutions and bring them to you.



NEWS

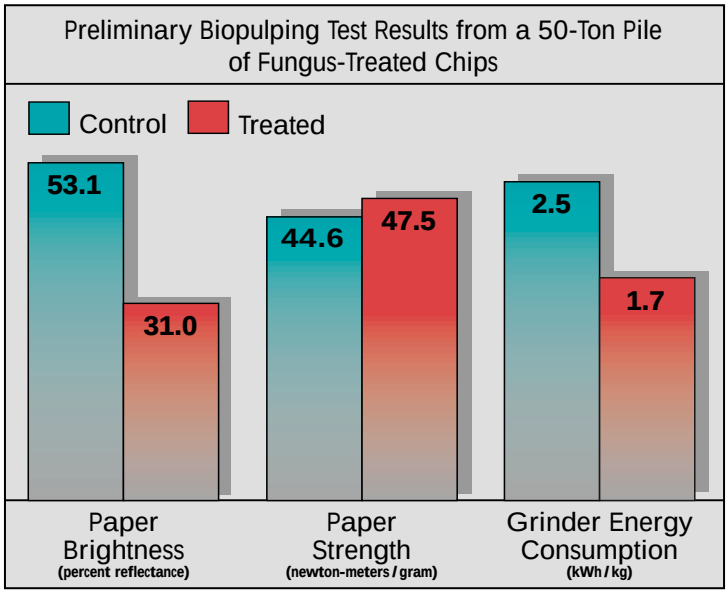
Biopulping: The Video

The Center has completed the first of two videos showing how paper mills can save energy and improve their products with *biopulping*. The first video focuses on laboratory and industrial-scale tests of biopulping, which were sponsored by the Center in cooperation with the USDA Forest Products Laboratory at the University of Wisconsin-Madison.

Biopulping uses a common fungus to soften wood chips prior to grinding at a paper mill. Tests on a 50-ton chip pile confirmed that the fungus treatment results in less bright, but stronger paper produced with about 30 percent less energy. At a large mill, that could translate to millions of dollars per year in energy cost savings.

The first video will be presented in March, 1997, at a Center workshop for Wisconsin paper mill executives. The second video will document the Center's final industrial-scale test planned for later in the spring, where Consolidated Papers, Inc. will process 50 tons of fungus-treated wood chips at their plant in Biron, Wisconsin. The video will be used to present biopulping technology to the paper industry nationally.

—Jeremy Kohler



FOR MORE INFORMATION about *biopulping* contact Dave Shipley at (608)238-8276 x39, dshipley@ecw.org. See also the article in the summer 1996 *E²*, or visit www.ecw.org/biopulp.html.

Public Benefits in Progress

After months of discussion among stakeholders—investor-owned and municipal utilities, rural electric cooperatives, public interest groups, and other organizations—the Public Service Commission of Wisconsin is nearing a decision on how to provide energy efficiency research and development and other public benefits in a restructured electric utility industry.

Recommendations from various stakeholders were due to the Commission by the end of January, 1997. After holding public hearings on the proposals around the state in February, the Commission is expected to recommend a plan to the Wisconsin legislature on March 27. Legislation on public benefits is anticipated in 1998.

Public benefits are economically beneficial goods and services that a purely competitive market would not adequately provide. Classic examples are national defense, public education, and firefighting. In the utility industry public benefits include energy-efficiency research, low-income energy services, renewable energy, and research on the environmental effects of power generation.

Currently utilities provide many of these public benefits and the costs are paid for in customer rates. But because restructuring could bring an end to utility-based public benefits programs, last spring the Commission invited Wisconsin stakeholders to develop a recommendation on how to provide public benefits in the future.

Although there is a general consensus among stakeholders on the need to provide public benefits through broadly representative public benefits boards, disagreement remains on where to set funding levels, how funds would be collected, and which government body would oversee the boards.

The Center is following the public benefits discussion closely—in an advisory role—and is engaged in research to help prepare Wisconsin for a more market-oriented approach to energy efficiency.

—Eric Nelson

FOR MORE INFORMATION on *Public Benefits* discussions, contact Gary Mathis at the Public Service Commission of Wisconsin at (608)266-2307. Also visit the PSC's home page at http://badger.state.wi.us/agencies/psc.

FROM THE DIRECTOR

Mark Hanson
Executive Director

I doubt that Varujan Shirinian—the Armenian whose painting found its way onto the cover of this year's annual report—would ever have imagined that so many people would have seen, and perhaps been moved by his work. My feelings about the Center's work are somewhat similar: I would not have imagined that so many people would have been influenced by our research reports, workshops, newsletters, web page, library services, videos, and other avenues of contact in the past year.

Requests for all manner of energy efficiency information and partnerships seem to increase steadily as the Center's wide range of activities and services grow. In 1997 we'll be offering new Professional Memberships to make it easier for organizations other than utilities to join the Center and take advantage of what we have to offer (watch for details in the Spring, 1997 E^2).

This issue of E^2 touches on some of our offerings, such as workshops for professionals and innovative public school energy education programs like School to Work (and yes, the children will soon be on your case about those incandescent lights).

Out in the field, we're partnering with Madison's University Research Park and private architectural firms to design an innovative "green building" for the Park, and we're testing out a new energy-efficient pulping process at a Wisconsin paper mill. Our partnerships with the University of Wisconsin are growing, with new research to develop high-efficiency technologies for Wisconsin's cheese industry.

As the energy market restructures, requests for services like energy efficiency are becoming more urgent But they shouldn't approach the desperation that Shirinian paints—for amidst all of the change that's sure to pass, many are working to assure that public needs will continue to be met. As this picture is brushed on the canvas, we at the Center look forward to helping create this new vision.

E² Science

Pumping Soil

If you're cold this winter, you might want to move underground. In Wisconsin, the temperature eight feet under is a nearly constant 45 degrees year round, thanks to the sun, even if it's 20 below outside. Heat pumps use this handy source of energy to efficiently heat homes.

A heat pump works like a refrigerator—from the point of view of the kitchen. Just as a refrigerator draws heat from the groceries and dumps it into the kitchen, a heat pump can extract heat from the soil and use it to warm up a house.

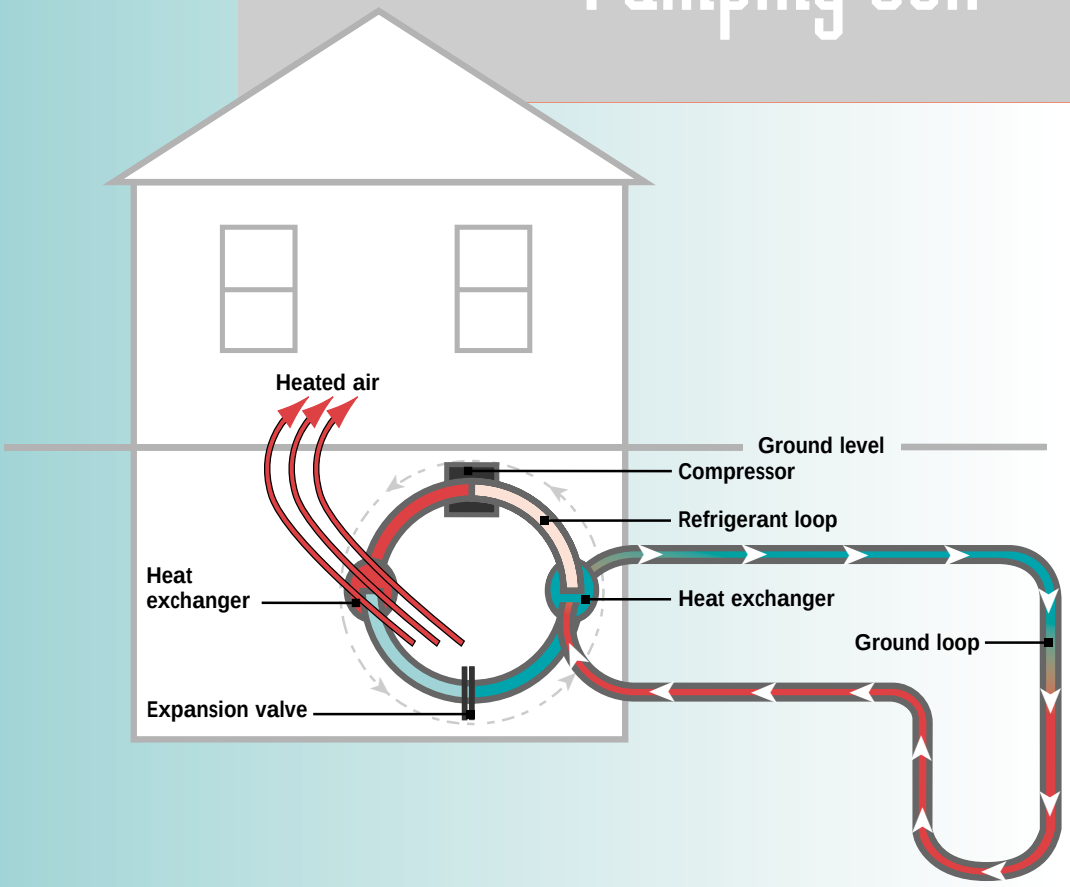
Down Under

A heat pump extracts heat with two loops of pipe—a *ground loop* and a *refrigerant loop*. The ground loop, typically filled with water and glycol (radiator fluid), collects heat from the earth. The refrigerant loop, which contains an easily compressed gas, absorbs heat collected by the ground loop, concentrates it, and moves it inside.

Super-Efficient—Hot or Cold

Heat pumps only move heat—they don't create it—and only use electricity to run compressors, pumps, and fans. And in the summer they can be run backward and used as an air conditioner, absorbing heat from the home and moving it underground. Because heat pumps move more energy than they use, they can achieve efficiencies of 200 to 400 percent.

Through its residential and industrial heat pump programs, the Center is demonstrating that heat pumps are a practical heating and cooling device for homes, offices, and industry.



How Cold Dirt Can Heat a Home

To use soil warmth, a heat pump must concentrate it first. This is necessary because heat only flows naturally from hot to cold, and the ground is at least 25 degrees cooler than room temperature. Here's how it works:

1. The ground loop collects soil warmth and, via a heat exchanger, warms up gas in the refrigerant loop.
2. A compressor pressurizes the refrigerant gas, causing it to warm further—to a point above room temperature.
3. The refrigerant heats house air via a heat exchanger.
4. A valve expands the refrigerant, which then gets very cold, much the way a deodorant spray does. The refrigerant is now cool enough to absorb more heat from the ground loop.
5. The cycle repeats.

—Eric Nelson

The ENERGY-EFFICIENT CURD

Research is paving the way for a more energy-efficient dairy industry

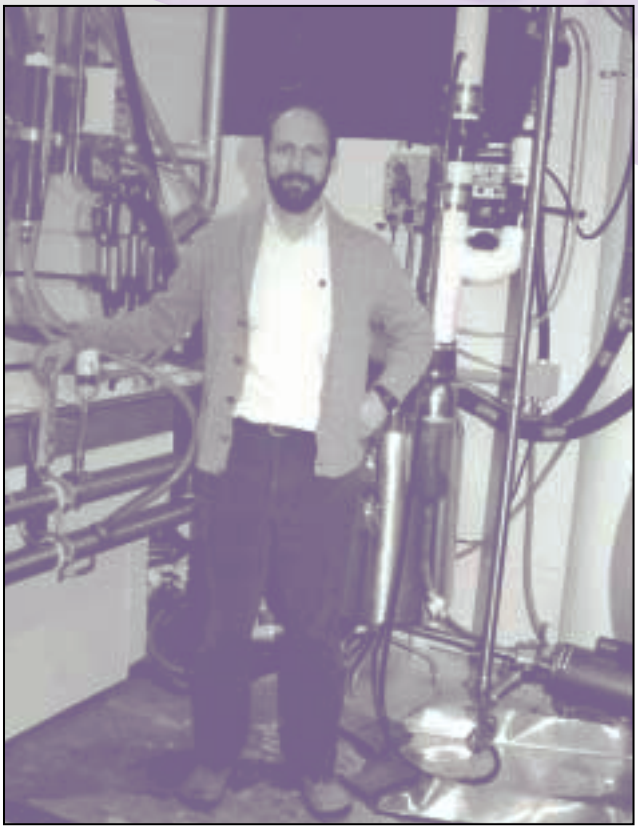
By Eric Nelson

In 1995 Wisconsin produced 2.1 billion pounds of cheese. To make that cheese, which represented approximately 30 percent of the nation's total production, dairies spent between 20 and 40 million dollars on energy. But can the cheese industry afford to pay that much?

"Energy costs are one to two cents per pound of cheese," says John Mitchell, professor of Mechanical Engineering at the University of Wisconsin-Madison. "That's a small percent of cost, but it's a major percent of profit."

"What we want to do is make the Wisconsin cheese industry more competitive," Mitchell says.

Being competitive means cutting the energy costs, not only of making cheese, but also of producing milk and processing byproducts. And a long-term Center research program has been doing just that.



University of Wisconsin-Madison Professor Doug Reinemann stands by a milking machine in the Agricultural Engineering Laboratory. The Center is sponsoring his research on efficient milking system design.

First Steps

Mitchell's colleague, University of Wisconsin-Madison Professor Doug Reinemann, has devoted part of his career to reducing energy use in agriculture. A researcher at UW-Madison's Milking Research and Instruction Lab, Reinemann sits on the Wisconsin Farm Electric Council, a twelve-member association of investor-owned and cooperative utilities that exchanges the results of agricultural energy research.

Reinemann has led Center-sponsored research on how to reduce the energy costs of crop irrigation and developed computer models to help people design more energy-efficient farms. More recent work is focusing on how to reduce the energy costs of producing raw milk.

But on dairy farms, energy efficiency isn't the only priority.

Streamlined Milking Systems

Dairy farms operate on very tight schedules. Cows are milked two or three times per day, every day. A farmer can't afford an equipment breakdown, and this led to milking systems designed by "overkill" — to work under the worst possible conditions. Reinemann set out to show that this overkill isn't needed for reliability.

"A milking system basically sucks milk out of the cows," says Reinemann. Suction is created by large pumps and distributed through a network of pipes to milking units. "It was generally recognized that these systems were oversized. So what we tried to do is start from first principles. What are we really trying to achieve in a milking system? And what's the best and most efficient way to achieve that?"

Regulating suction is one critical goal. "If the suction is too low, you don't get any milk. If it's too high, you can injure the cow," he says.

Dr. Graeme Mein, a member of the UW milking research team, found ways to regulate vacuum suction more efficiently—allowing the use of smaller vacuum pumps that consume less energy.

But there was a barrier to implementing this result. People thought that extra pumping capacity was needed for cleaning. Reinemann showed this wasn't true by developing ways to clean the milking machine using smaller-capacity pumps.

Reinemann's team also showed that milking systems could use smaller milk lines, reducing the amount of hot water needed for cleaning.

Mein's and Reinemann's recommendations have been implemented and tested in more than a dozen Wisconsin farms and recently became official in the dairy industry by becoming part of the 1996 revision of the ASAE (Society for engineering in agricultural, food, and biological systems) S518 standards for milking systems.

Testing has shown that the newly designed systems are just as reliable as older systems and reduce the energy costs of producing milk from its current five percent slice of the total, down to two percent.

"It's probably not going to make or break a dairy farm," Reinemann comments. "But it's more than pocket change. We could be talking several thousand dollars a year, very easily."

Cheesy Thermal Storage

Efficiency doesn't stop at the farm. It just flows on toward the dairy, where the Center is beginning a long-term effort to reduce energy use in the food processing industry.

One of the biggest energy costs in the cheese industry is refrigeration. At a dairy in Marshfield, where Mitchell and Reinemann are studying possible energy-saving measures, operators produce approximately 160,000 pounds of cheese each day that must be cooled from 97 to 45 degrees. That's a costly refrigeration load, especially during the day when industrial electricity rates are highest.

One way to bypass these costly rates is to refrigerate at night and store cooling capacity in the cheese itself by cooling it a few extra degrees *below* its normal temperature. During the day, with the refrigerator off, the cheese gives off the extra cooling energy to the air as it warms back to its normal storage temperature.

"Think of several million pounds of cheese in a room," explains Mitchell's graduate student Steve Zehr. "By allowing small temperature swings in this cheese, you can meet nearly all of your daytime cooling needs in that space."

PHOTO COURTESY OF FOREMOST FARMS USA, BARABOO, WISCONSIN.

Inside the Marshfield, Wisconsin cheese plant.

This simple, inexpensive technique could save the Marshfield plant approximately $15,000 per year in electricity costs, according to Zehr.

The Way to Efficient Whey

The cheese industry also stays competitive by selling byproducts, such as whey. At the same Marshfield dairy, the Center is studying the energy-efficient processing of this yellow protein-rich liquid that is used in baby food, soups, and many other foods.

To make whey more useful, dairies concentrate it by evaporation, using steam heating. In the process, the steam used to heat the whey becomes a cool vapor that's treated as a waste product and vented outside. But this vapor still contains latent energy—the heat used to turn water to vapor.

Reinemann and Mitchell want to release this untapped energy by condensing the vapor—releasing the latent heat—and using heat-recovery devices or heat pumps to collect and distribute it.

The Center and the University: An Efficient Partnership

To help fulfill its mission of energy education and basic research, the Center collaborates with the University of Wisconsin-Madison—a partnership that has helped both parties stretch resources.

For example, the Center has helped keep agricultural energy efficiency a priority in a time when utility energy-efficiency budgets are shrinking. "One of the things we've tried to do," says Doug Reinemann, Professor of Biological Systems Engineering at Madison's Milking Research and Instruction Lab, "is to pool resources so that we can still do some work in ag and get that information out to utilities."

The Energy Service Education and Research Committee was formed by the University and the Center to help support basic research related to energy efficiency. ESERC solicits proposals from the University and selects projects that meet two criteria.

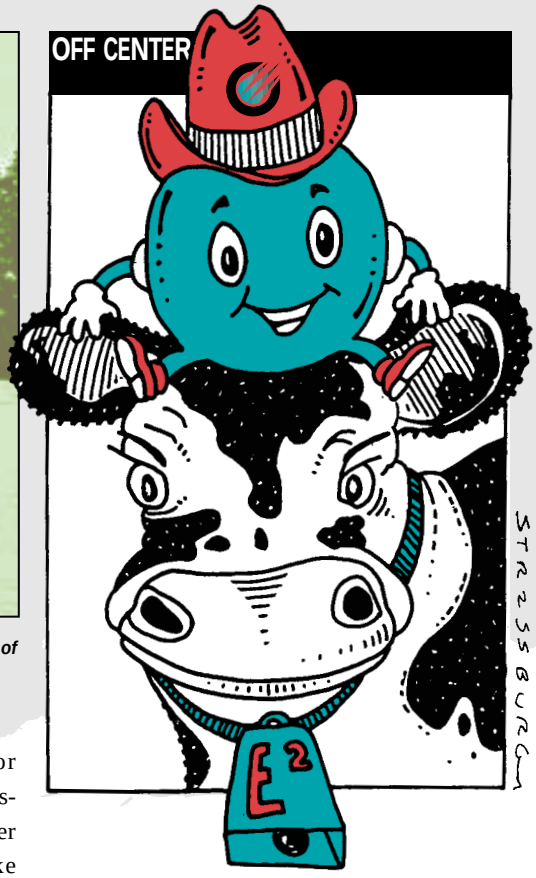
"One is long-term projects," says John Mitchell, Professor of Mechanical Engineering at the University of Wisconsin-Madison, and Chair of ESERC. He says that the energy industry often changes slowly, but that the need for a policy decision can arise much more quickly. "We want to look long term at establishing a base of information so that—when something does happen—people can make quick policy decisions."

"Another goal is looking at broader impacts," Mitchell continues. "We try to work on projects that bring more than one discipline to bear on the problem. This puts us at an interface between disciplines that helps us see how a project will actually impact people, society, and utilities."

—E.N.

PHOTO COURTESY OF FOREMOST FARMS USA, BARABOO, WISCONSIN.

Cheese plant in Marshfield, Wisconsin, where UW-Madison scientists are testing ways to reduce the energy costs of producing cheese and whey.



The idea is "to make use of energy that would normally just go off as waste heat and put it to some productive use," says Reinemann. For example, the waste heat could heat cleaning water or prewarm milk before it's pasteurized. Zehr estimates that waste heat recovery could save the Marshfield plant as much as $76,000 per year in natural gas costs.

Mitchell sees many opportunities for large-scale energy savings as the dairy industry consolidates: "We think some the bigger companies may have the ability to take advantage of high technology and see paybacks that make sense."

In the future, the Center plans to examine the canning industry, another large-scale enterprise that could profit from energy efficiency.

FOR MORE INFORMATION about agricultural research contact Ruth Urban at (608)238-8276 x17, rurban@ecw.org.

NEWS

A Grand Idea

"There's no better way for kids to become enthusiastic about a topic than to hear other kids talk about it," says Center project manager Kathy Kuntz. Working under this model, some students at Grand Avenue Middle School in Milwaukee have stepped forward to spread the word about energy efficiency.

On May 28, 1997, Grand Avenue's students in grades six through eight will put on "A Grand New Energy Conference" for other middle school students throughout Wisconsin. The Grand Avenue students have learned a lot about energy—they want to share what they know and encourage other kids to save.

At the conference, participants will be able to attend workshops—taught by Grand Avenue students—on topics like energy careers, home energy conservation, renewable energy, and fossil fuels. And nearly 30 student exhibits will add information on solar-powered cars, energy-efficient building design, and weatherization.

The energy conference is one of many projects stemming from the energy theme that underpins the curriculum of a 120-student "family" at Grand Avenue. It's all part of the *School to Work Energy Education Project* sponsored by the Center. Through SWEEP, students use energy as a theme to gain "real world" knowledge of core subjects like literature and math.

Grand Avenue students created logos for T-shirts and invitations to help promote their conference.

As the energy conference continues to take shape, the Grand Avenue students get closer to seeing all their hard work—planning the agenda, recruiting a keynote speaker, developing presentations—come together to create one successful conference.

"As a school-to-work activity, this conference has given them many opportunities to talk about all sorts of careers and it has provided invaluable, and probably unforgettable lessons on teamwork," says Kuntz. "The conference gives them a way to explore careers tied to an issue they care about. But most importantly from their perspective, it gives them a way to promote energy efficiency to other students."

—Carolyn Dunn

FOR MORE INFORMATION on *A Grand New Energy Conference* check out the students' ad on page 13. To learn more about *SWEEP* contact Kathy Kuntz at (608)238-8276 x24, kkuntz@ecw.org, or see the Summer 1996 *E²*.

Energizing Libraries

Showerheads, electricity meters, and lumps of coal aren't what you'd expect to find at your public library, but thanks to an innovative utility-library partnership and some help from the Center, expectations are changing.

Since June 1995, Madison Gas & Electric Company has worked with the Dane County Library Service's 17 municipal libraries to disseminate energy information. The partnership—with funding from the Wisconsin Environmental Education Board—has created library displays, home-energy workshops, and do-it-yourself tools that patrons can check out.

"The libraries have been able to enhance their collections with the energy materials provided through the partnership, and those materials are circulating at a very high rate," says Center librarian Andrea Minniear. The Center is now evaluating the partnership for its influence on how people are using energy.


PHOTO BY LEROY BRANDT, COURTESY OF MG&E.

"We're determining the value of the partnership in terms of how well the circulating materials, library displays, and home energy workshops meet their intended goals," Minniear says, "and we may have an opportunity to help design and support future partnerships elsewhere in Wisconsin."

Recently the Center held workshops in Wisconsin Rapids and Oconomowoc on how to form successful utility-library partnerships.

—Jeremy Kohler

FOR MORE INFORMATION about *utility-library partnerships* contact Andrea Minniear at (608)238-8276 x26, aminniear@ecw.org.

It's Inefficient, Sherlock

Market researchers investigate how we use energy and why we waste it

By Jeremy Kohler

The most difficult crime to track is the one which is purposeless.

—Sherlock Holmes

It's the case of the lost energy, and the culprit is inefficiency. In our highly energized world, tracking down the perpetrators takes a special kind of gumshoe.

"You must understand how the entire market works—who makes the key decisions and what motivates them," explains Center project manager Bobbi Tannenbaum, who's investigating energy use in Wisconsin's rental sector.

"Energy use in the rental sector is very inefficient. We want to look at the different types of owners, management companies, and renters to find out how these different segments make energy-related decisions."

Inefficiency in apartments is one of many "crimes" that market researchers at the Center are trying to solve, so that they can devise ways to help prevent energy waste. And it's not a simple whodunit—inefficiency is usually an unintended byproduct of a complex and often mysterious web of market forces that dictate how we use energy.

As a market investigator your task is to uncover the source of waste, find out what's causing it, and figure out how to put a stop to it. Bring your magnifying glass—clues are everywhere.

The Scene of the Crime

At the center of the energy marketplace are the "end users"—the people who use energy by running appliances or other equipment. End users, such as homeowners, can help you spot sources of inefficiency.

The Center's ongoing *Appliance Sales Tracking* project, for example, surveys thousands of Wisconsin residents every two years on what kinds of refrigerators, furnaces, water heaters, and air conditioners they're purchasing. The data can tell you what parts of the appliance market are weak in terms of energy efficiency. And periodic surveys let you monitor changes over time.

"Sales tracking identifies trends in the market," explains Center project manager John Peloza. "This information could be used to evaluate programs that are designed to influence those trends. Sales tracking also shows you where the problems are, and gives clues about how to address them."

Peloza says the surveys are collecting reliable information about refrigerators and water heaters, and have shown that electric and gas efficiency seems to be improving in those markets. But for other appliances, such as furnaces, most residents aren't able to find enough information about their equipment for researchers to determine efficiency levels.

In a complex marketplace, however, one trail always leads to another.

Motives

Contractors who install furnaces, construct buildings, or provide weatherization can influence their customers' decisions about energy efficiency, especially when contractors offer a select range of products or services. They also know what kinds of equipment their customers are using.

The Center recently completed a series of projects called *Tracking the Market for Energy Efficiency Services*, which collected information through in-depth interviews with heating, ventilating, and air conditioning (HVAC) contractors, as well as builders, insulators, and low-income weatherization providers.

"According to the contractors we spoke with, about 85 percent of new furnaces installed are at least 90-percent efficient," Peloza says. "But that 85 percent appears to be coming down in some regions, perhaps because of discontinued rebates or a reduced emphasis on energy efficiency coming from utilities, equipment distributors, and contractors."

These interviews were more in-depth than the telephone surveys used for appliance sales tracking, but involved smaller samples of people. "This kind of research helped us understand the contractor market and the range of services they offer," Peloza says.

He notes that although this evidence for declining efficiency is qualitative (see *Weighing the Evidence*, page 12), it provides some valuable information about what is happening to the market and where to look for more clues.

Opening the Books

Sales records from distributors—companies that sell the energy-related equipment and appliances to contractors—may provide some of the best evidence of where energy is being lost and whether efficiency is going up or down over time. To find out if there is a substantial widespread downturn in the market share of high-efficiency furnaces, for example, the Center is talking to equipment distributors.

"We are trying to verify and quantify the downturn by collecting sales data from

continued

distributors, to see what proportion of furnaces sold are high-efficiency," Peloza explains. "We're also asking them how they promote their products. Then we'll have enough information to identify causes of reduced efficiency in the market and recommend solutions."

It often takes a lot of footwork, however, to collect that kind of hard evidence. "Sometimes it's difficult to get company sales information because it is sensitive," notes Center project manager Scott Pigg, who is heading an evaluation of the Center's high-efficiency motors programs. He's collecting sales data from distributors of high-efficiency motors, but he says people are understandably reluctant to hand over their sales records.

"Although we use sales records to increase our basic understanding of the market," Pigg says, "companies fear that their competitors might obtain the information and use it to develop competitive sales strategies."

Tips

When you start asking questions about energy use, equipment installation, and sales, sometimes you'll get an unexpected break. Discussions with contractors, for example, revealed some technical problems associated with new energy-efficient design.

"HVAC contractors were reporting that replacing old furnaces with high-efficiency units—which bypass the chimney—sometimes caused existing water heaters to vent improperly," Peloza explains, "leading to a potentially dangerous buildup of exhaust gases. Some installers still aren't aware of the problem."

Peloza says it's technically simple to prevent the problem, and all that may be needed is an information campaign targeted to furnace dealers and installers to raise awareness.

Another outcome of discussions with contractors was a general feeling that many contractors haven't been trained to provide proper ventilation in well-insulated, "tight" buildings. The result has been problems with indoor air quality.

"Right now we're identifying economical and efficient ways to ventilate well-insulated houses," Peloza says. "We're also developing a program to train and encourage contractors to use these ventilation techniques."

Case Closed?

Knowing how the entire market works—in every detail—might be something market researchers strive for but never really expect to achieve—especially when faced with moving targets like the technology and energy-service markets. One of the big movements ahead is the restructuring of Wisconsin's electric utility industry.

"Much of the impetus for market tracking right now is that we know big changes are coming along due to restructuring of the electric power industry," Pigg explains. The changes, he says, are likely to have a significant effect on how energy efficiency fits into the marketplace.

"We need to document what happened under restructuring so we can know how to help the energy-efficiency markets adapt to the changes."

Peloza adds that market tracking also has a long-term outlook. "Our approach is to monitor changes in the market, whether they are influenced by the regulatory climate, technological change, or other market dynamics."

FOR MORE INFORMATION about the Center's market research projects contact John Peloza at (608)238-8276 x21, jpeloza@ecw.org.

Weighing the Evidence

'On the contrary, Watson, you can see everything. You fail, however, to reason from what you see.'

When Sherlock Holmes observed a mixture of hard evidence and circumstantial evidence, he applied his rigorous logic to deduce the truth. Tracking down crimes of inefficiency involves a slightly different mixture of information—of quantitative and qualitative evidence—to deduce what is happening in the market, and why.

Quantitative data is derived from large, statistically representative samples of the population, and can be used to draw general conclusions. *Qualitative* data, on the other hand, is collected from smaller, nonrepresentative groups of people—such as focus groups—but tends to be much more detailed.

"The value of qualitative data is that although it is less broad, it explores issues deeper," explains Center project manager Bobbi Tannenbaum. "Qualitative research is useful when you don't know much about the topic—it helps you identify the biggest issues and shape your investigation."

"Our discussions with contractors helped us understand how contractors do business," says Center project manager John Peloza, who collected qualitative data on attitudes and practices through contractor interviews. "With this information, we can start looking for ways to help contractors build more energy efficiency into their services."

Center project manager Scott Pigg says that although you can't generalize from qualitative data, it is often an essential precursor to more broadly applicable research. "You have to start with qualitative data in order to know what kind of quantitative data you want to gather," he explains. He also says qualitative data can tell you things that quantitative data isn't likely to reveal.

"Qualitative data gives you information that can be immediately useful—the HVAC contractors in the interviews were crying out for objective information on technologies and products...all they had was manufacturer literature which tends to be biased. So we identified a market need right there."

Pigg says that we'll always need both quantitative and qualitative data, although neither is ever as broad or as deep as one would like. "Quantitative data tells you where we are. Qualitative data can tell you why we are where we are and what we can do about it."

ENERGY JARGON

By Eric Nelson

T N E C S E R O U L F T C A P M O C
H Y D R O E L A O C A V H O C R O E
E N E R G Y E A C H I P S R L O W E
R P E E K E D R E B A T E W L S D T
M T R A N S M I S S I O N I E N N E
O S E T I D U A N A F U N D L E W C
S O W O R K S H O P U G W C E S P H
T C O M M I S S I O N I N G C N G A
A G D X B R E F R I G E R A T O R S
T N A C Y H E A T P U M P S R I O O
L I Y D A G E S E E S E E L I T W L
P T L N M R A T O K B T U O C O U A
A A I I E R A S A U C E P A N M P R
Y R T W S L E E E L R R S D E E N E
B E O A U A P H D A U C C N D N E P
A P R S D B V T T A W G E G S U E O
C O N S E R V E J O U L E S M A R R
K I Y W R E S T R U C T U R I N G T

Look for a 15-letter phrase in the unused letters.

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Try to find words we use at the Center to talk about energy efficiency:

AIA *(American Institute of Architects)*
atom
audit
BTU *(British Thermal Unit)*
CEE *(Consortium for Energy Efficiency)*
chips
coal
code
commissioning
compact fluorescent
conserve
cooling
data
daylit
DLC *(Direct-Load Control)*
DSM *(Demand-Side Management)*
ECW *(Energy Center of Wisconsin)*
electric
energy
fund
fungus
gas
gas load
green
grow
heat pumps
HVAC *(Heating, Ventilating and Air Conditioning)*
hydro
insulate
joule
KEEP *(K-12 Energy Education Program)*
load
low E
lumen
menu
meter
motion sensor
fan
operating cost
oxy-gas
payback
peaks
POS *(Performance Optimization Service)*
power
PSC *(Public Service Commission)*
RAC *(Research Advisory Committee)*
rates
rebate
refrigerators
regulate
report
resources
restructuring
RPM *(Responsible Power Management)*
save
SEER *(Seasonal Energy Efficiency Rating)*
solar
SWEEP *(School to Work Energy Education Program)*
tech
therm
thermostat
transmission
watt
web
wind
workshop

Solution on page 26

E² Science

The Frugal Furnace

Heating technology has come a long way since the brazier—bronze pots, which burned coal or wood, used by ancient Romans for central heating. After centuries of lessons learned from fireplaces, stoves, and boilers, the forced-air furnace was developed in the late 19th century, thanks in part to the electric fan.

In the 1960's, forced-air furnaces were typically only 60 to 65 percent efficient, according to Mark Enger, heating contractor for Phil's Refrigeration in Lake Geneva, Wisconsin. Today's best furnaces turn nearly 97 percent of their fuel into useful heat. The rest goes up the chimney, or more likely today, out a plastic pipe.

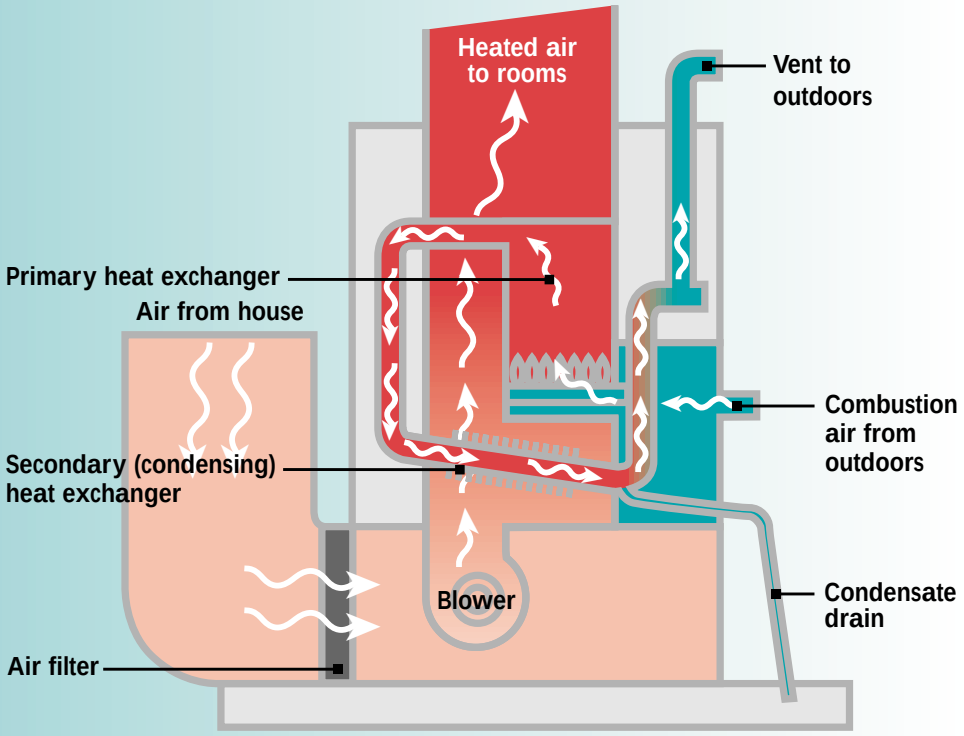
Furnace Fundamentals

A forced-air furnace consists of an enclosed burner, a fan, and air ducts. An electric fan pulls house air into the furnace, blows it over the heat exchanger—similar to a heating stove—and then forces the warmed air back into the house through a network of ducts. The heat exchanger allows the fire to warm house air while containing exhaust from the burning fuel.

More Heat for Your Money

High-efficiency furnaces are efficient, for one, because they burn fuel more completely. A perfect gas flame produces only heat, carbon dioxide, and water. By using proper mixtures of air and gas and well-designed burners, efficient furnaces approach this ideal of a "smokeless" fire and extract the maximum amount of heat out of the fuel.

Efficient furnaces also use less fuel by harnessing exhaust heat, which in a standard-efficiency unit just goes up the chimney. In a high-efficiency furnace a second heat exchanger absorbs the exhaust heat and uses it to prewarm house air. By tapping into the heat of the fire twice, the furnace doesn't have to work as hard, and the exhaust is cool enough to be vented through a plastic pipe—a chimney isn't needed.



Some furnaces can also cut down on infiltration—air that leaks into your house. Furnaces, like fireplaces, draw cold air into the house to replace the exhaust that goes out. To avoid this, sealed combustion units draw combustion air into the furnace directly from the outside.

Because they save money and energy, the Center is tracking sales of efficient furnaces (see also page 10), and in the future hopes to see even fewer of Wisconsin's heating dollars go up the chimney.

—Eric Nelson

E² energy efficiency

1996 financial report

ENERGY CENTER
OF WISCONSIN

The Energy Center of Wisconsin is a private nonprofit organization funded primarily by voluntary contributions from Wisconsin's utilities. ECW's Board of Directors selects projects and plans programs, which are overseen by the Research and Program Advisory Committees. Smaller working committees and Center staff provide additional guidance and expertise. Member organizations provide the bulk of the Center's financial support. Representatives from both member and participant organizations serve on committees and on the Board of Directors.

We invite participation, collaboration, and support from any organization that shares the Center's mission. Contact the Center for information on how to participate or become a member.

MEMBERS

Badger Power Marketing Authority of Wisconsin
Madison Gas & Electric Company*
Manitowoc Public Utilities
Marshfield Electric and Water Department
Northern States Power Company-Wisconsin*
Pardeeville Public Utilities
Rice Lake Utilities
Superior Water, Light and Power
Wisconsin Electric Power Company*
Wisconsin Power & Light Company*
Wisconsin Public Power, Inc. SYSTEM
Wisconsin Public Service Corporation*

PARTICIPANTS

Badger Safe Energy Alliance
Citizens' Utility Board*
Kohler Company
Midwest Renewable Energy Association
Municipal Electric Utilities of Wisconsin*
National Association for the Advancement of Colored People
National Center for Appropriate Technology*
Opportunities Industrialization Center of Greater Milwaukee
Plumbing & Mechanical Contractors Association*
Public Service Commission of Wisconsin*
RENEW Wisconsin
University of Wisconsin Extension
University of Wisconsin-Madison*
Wisconsin Manufacturers & Commerce

*Representative serves on the Board of Directors

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Madison Gas & Electric Company

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Joan Braun
Plumbing & Mechanical Contractors Association

Michael Gregerson
Northern States Power Company

Richard Krueger
Wisconsin Public Service Corporation

Chuck Mitchell
Citizens' Utility Board

John Mitchell
University of Wisconsin-Madison

Revenue Fiscal Year 1996

For the year ended June 30, 1996

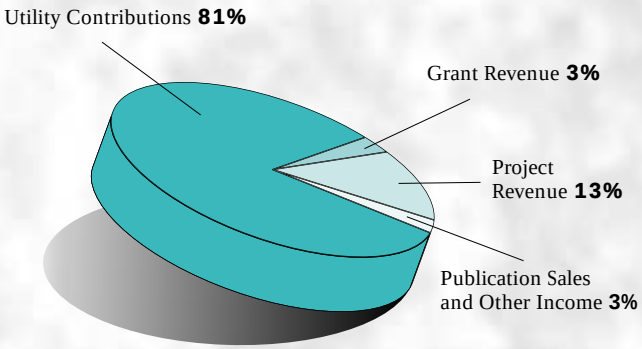
Utility contributions	$2,859,922
Grant revenue	110,426
Project revenue	461,704
Publication sales and other income	90,401
Total Revenue	**$3,522,453**

Expenditures Fiscal Year 1996

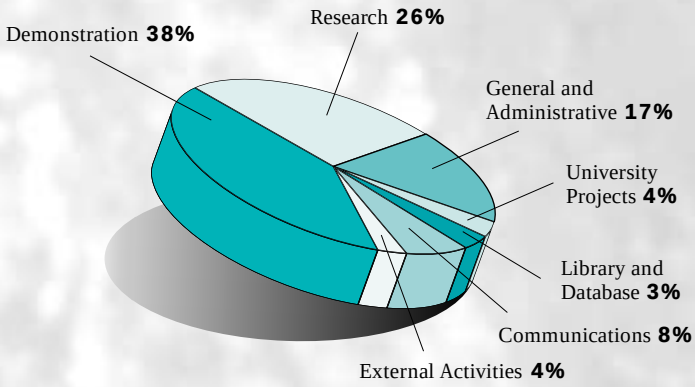
For the year ended June 30, 1996

Program services	$2,923,956
Research programs	910,990
Demonstration programs	1,321,641
Library and database	117,320
Communications programs	274,534
University projects	156,663
External Activities	142,808
General and administrative	598,497
Total Expenditures	**$3,522,453**

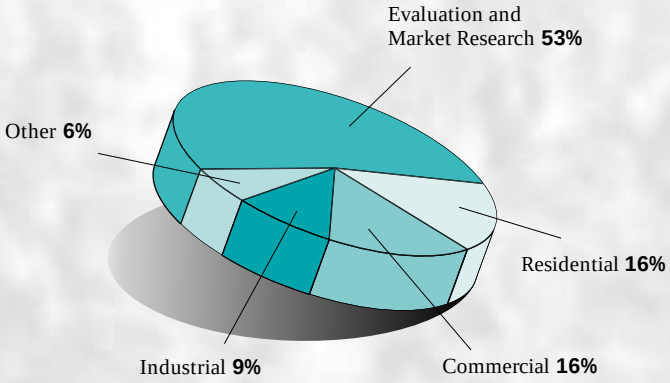
Sources of Income



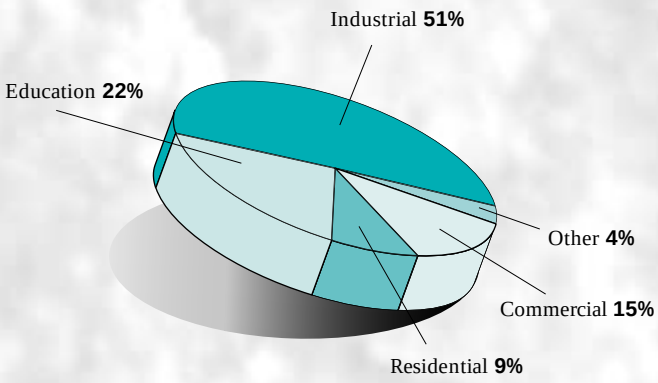
Application of Funds



Distribution of Research Funds



Distribution of Demonstration Funds



Fusion Energy

By Jeremy Kohler

PHOTO COURTESY OF AEC

The Industrial Electrotechnology Laboratory (www.iel.ncsu.edu), a program of the **North Carolina Alternative Energy Corporation**, provides testing, consultation, workshops, and publications in support of energy-efficient industrial processes, such as this demonstration of radiofrequency drying.

State energy centers are generating a nationwide network for information exchange and collaborative research

At the Sun's core, atoms fuse together to create energy. Here on Earth, state "energy centers" are coming together for a similar reason—not to build the first fusion reactors, but to build partnerships that create energy from efficiency and alternative resources.

About ten years ago representatives from the California Institute for Energy Efficiency, the Ohio Energy Office, the Florida Solar Energy Center, and the New York State Energy Research and Development Authority (NYSERDA) sat down to trade stories about state-based energy research and development. Among them was Jack White, NYSERDA's president at the time.

"We discussed establishing an organization of state institutions as a loose confederation," White recalls. "The ability to exchange information was valuable in itself, and we saw ways in which we could work collaboratively."

The result was the formation in 1990 of the Association of State Energy Research and Technology Transfer Institutions. Today the Energy Center of Wisconsin is among a growing network of 19 state-based ASERTTI organizations devoted to energy efficiency and alternative energy. Through ASERTTI, the Center is helping establish a new system for cooperation across state boundaries.

"ASERTTI helps us keep in touch with groups who are doing similar work, and prevents duplication of effort," says Center executive director Mark Hanson. "It allows us to inform each other as well as learn from each other."

Hanson says one of ASERTTI's greatest benefits is its potential to bring members together on projects that benefit the nation, not just individual states. "Collaborative research allows a broad group of people to support a broad benefit," Hanson explains. "And it allows us to do things together—by leveraging our research budgets—that we could never do on our own."

Hot Spots

One thing that ASERTTI members are doing together now is pooling their knowledge so that energy centers can build upon the combined experience of all ASERTTI organizations. The *Review of State Energy Research, Development,*

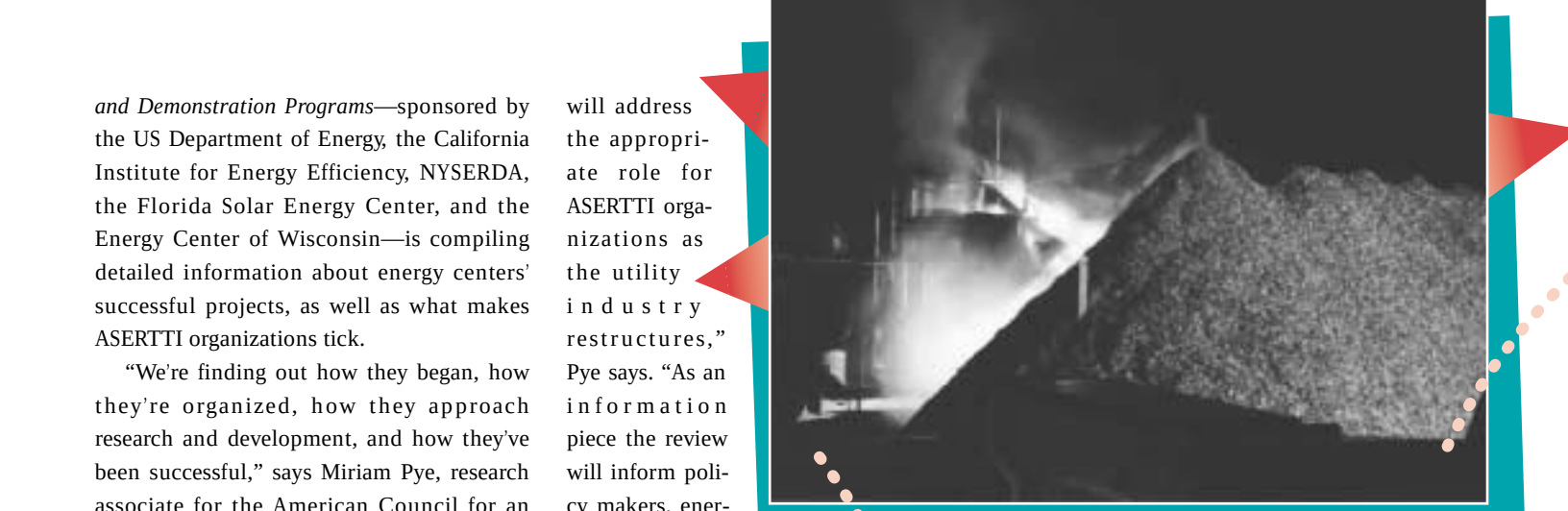
and Demonstration Programs—sponsored by the US Department of Energy, the California Institute for Energy Efficiency, NYSERDA, the Florida Solar Energy Center, and the Energy Center of Wisconsin—is compiling detailed information about energy centers' successful projects, as well as what makes ASERTTI organizations tick.

"We're finding out how they began, how they're organized, how they approach research and development, and how they've been successful," says Miriam Pye, research associate for the American Council for an Energy-Efficient Economy, an independent nonprofit research organization that is conducting the review.

In addition to describing how each ASERTTI organization works, Pye has visited several—including the Energy Center of Wisconsin—to develop case studies of successful projects.

"We will have a cross section of case studies," Pye says, "on transportation, industry, buildings, renewable resources, municipal programs, and low-income services." She notes that these kinds of projects are broadly applicable, not specific to any one geographical region.

Utility industry restructuring is also not limited to a particular region, and it will mean a new climate for energy centers. "We will address the appropriate role for ASERTTI organizations as the utility industry restructures," Pye says. "As an information piece the review will inform policy makers, energy professionals, and the public about state energy research and development organizations' status, funding, achievements, and rationale for existence."



Fifty tons of wood chips serve as the testing ground for a new biopulping technology designed to save energy and reduce chemical use at paper mills (see also page 3). The **Energy Center of Wisconsin** is sponsoring industrial-scale tests of biopulping at the University of Wisconsin-Madison and at a Wisconsin paper mill.

The information will also serve as a guide for states or regions interested in creating new energy centers. From her visits and interviews with ASERTTI organizations, Pye is finding that there are lots of ways to set up an energy center. She notes, for example, that some organizations do mostly in-house work, some work primarily in partnership with private business, and some are university-based.

"They all developed very differently," she says. "It will be interesting to see if there's a common thread."

PHOTO COURTESY OF NYSERDA

A 90-kilowatt solar photovoltaic system is part of a **New York State Energy Research and Development Authority** project at a state university on Long Island. For more than 20 years, NYSERDA's programs have focused on industry and applications, buildings, energy resources, transportation, and environmental research.

Quantum Leaps

Just how the roles of energy centers will change as energy markets restructure themselves around the country is not known. One possibility is that ASERTTI organizations will have more work to do.

Center project manager Dan York, who's keeping an ear to discussions on the future role of energy efficiency in Wisconsin and elsewhere, says that ASERTTI organizations could grow in prominence if restructuring results in decreased support for current public benefits programs like utility energy-efficiency programs.

"ASERTTI and its members may have a role to play in balancing some of the effects of shrinking federal support and utility deregulation around the country," he says. "If regulated services diminish, ASERTTI organizations could be the natural ones to jump in and fill the void, providing energy research and development, and possibly energy-efficiency services."

York notes that restructuring of the energy industry in Wisconsin is still developing, and no decisions have yet been made regarding the provision of public benefits (see also page 3).

Gravitational Attraction

Even as federal energy programs shrink, they are by no means disappearing. And ASERTTI organizations may have much to offer the federal government through mutually beneficial collaborative projects.

"ASERTTI members have expertise and funding to contribute to projects that the federal government is interested in," says White, now a senior partner with UTECH, Inc., a strategic planning and technology marketing firm. Through the Center, ASERTTI has retained UTECH in a project to make ASERTTI more accessible to the federal government so that a collaborative research and development agenda can be developed.

"Until now ASERTTI has only periodically had a presence in Washington,"

White explains. "The attempt now is to have a continuing presence to nurture and maintain relationships that can benefit the states and the nation overall."

White and representatives of several ASERTTI organizations are meeting with the US Department of Energy and the Environmental Protection Agency to identify areas of common interest and potential joint projects. Some energy-efficiency areas they're exploring include commercial building design, motor systems, innovative heating, ventilating, and cooling, industrial and municipal wastes, and market transformation.

"We're identifying our potential partners and facilitating interactions with those people," White says. "We plan to maintain those relationships to allow joint planning of research and development." He says ASERTTI will have a permanent, formal arrangement in place to support R&D partnerships in the future.

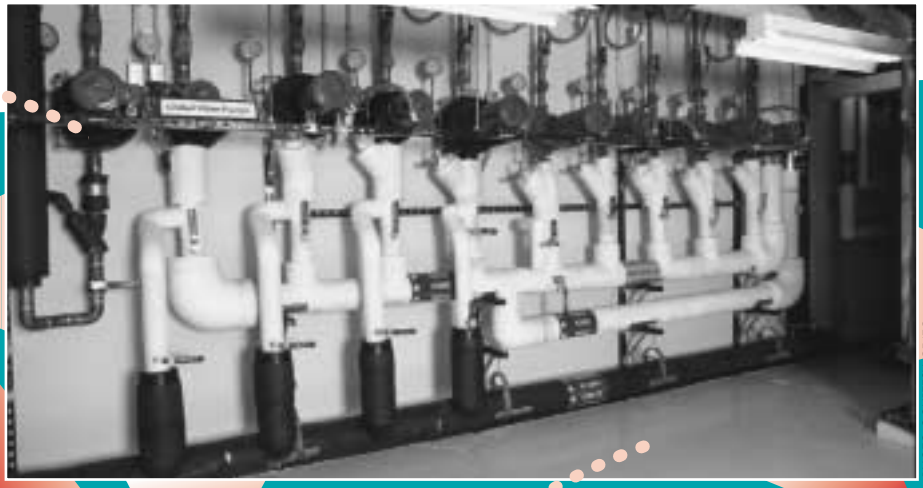


PHOTO COURTESY OF IEC

The **Iowa Energy Center's** Energy Resource Station is the only public facility in the nation that tests entire commercial-scale HVAC systems. In addition to testing new HVAC system designs, ERS provides hands-on operational training of professionals and educational programs for students.

FOR MORE INFORMATION about the Center's involvement with *ASERTTI* contact Mark Hanson at (608)238-4601, mhanson@ecw.org.

Fueling ASERTTI

The Association of State Energy Research and Technology Transfer Institutions is an information and research network maintained by its members. ASERTTI's current president is F. William Valintino, president of the New York State Energy Research and Development Authority. For information contact ASERTTI's manager of research planning, Janet Joseph, at:

New York State Energy Research and Development Authority
Corporate Plaza West
286 Washington Avenue Extension
Albany, NY 12203-6399
Ph. (518) 862-1090 x3296
Fax (518) 862-1091
jj2@nyserda.org.

Visit ASERTTI's web site at *www.nrel.gov/documents/aserti/aserti.html.*

ASERTTI Members

California Energy Commission *www.energy.ca.gov*
California Institute for Energy Efficiency *eande.lbl.gov/CIEE/ciee_homepage.html*
Connecticut Office of Policy and Management
Energy Center of Wisconsin *www.ecw.org*
Energy Systems and Resources Program, University of Missouri-Columbia
Florida Solar Energy Center *www.fsec.ucf.edu*
Hawaii Dept. of Business, Economic Development, and Tourism *www.hawaii.gov/dbedt*
Iowa Energy Center *www.energy.iastate.edu*
Kansas Electric Utilities Research Program *keurp.tisl.ukans.edu*
Massachusetts Division of Energy Resources *www.state.ma.us/doer*
Minnesota Building Research Center
Missouri Environmental Improvement and Energy Resources Authority
Nebraska Energy Office
New York State Energy Research and Development Authority *www.nyserda.org*
North Carolina Alternative Energy Corporation
Oregon Department of Energy
South Carolina Energy R&D Center
Virgin Islands State Energy Office
Washington State University Energy Program *www.energy.wsu.edu*

PHOTO BY STEVEN C. SPENCER, COURTESY OF F.S.E.C.

Designed to be the world's most energy-efficient building, the **Florida Solar Energy Center** is expected to use one-third the energy consumed by a comparable standard Florida office building. FSEC's new facility demonstrates a money-saving combination of high-efficiency building design, innovative daylighting techniques, and high-efficiency air conditioning.

NEWS

Efficient Refrigerator Program Breaks Sales Projections

Wisconsin housing authorities are buying Maytag refrigerators by the truckload. Since the last report on the Center's *Efficient Apartment Refrigerator* project in the Summer, 1996 *E²*, housing authorities in Madison, Superior, Oshkosh, and several other cities have joined Milwaukee in ordering the efficient Magic Chef. Wisconsin alone is purchasing 3068 units, while national sales have topped 77,000—11,000 more than anticipated.

Under a bulk purchase agreement arranged by the Consortium for Energy Efficiency, housing authorities and utilities were able to order Magic Chefs in increments of 89—one full truckload—for $308 apiece plus a $12 per unit delivery charge. The Center helped spread the word about the program and coordinated orders with CEE.

The 14.8-cubic-foot Magic Chef has an estimated annual energy consumption of 437 kWh per year and features automatic defrost, two slide-out shelves, a full-width crisper drawer, and a covered dairy compartment. The first units are scheduled for delivery in March, 1997.

Center project manager John Peloza hopes to expand the project in the future. "We want to utilize the distribution system that's out there to get units to a broader range of customers, like private-sector renters. Maytag is also introducing an efficient front-loading clothes washer that we might combine with the refrigerator effort."

—Eric Nelson

FOR MORE INFORMATION about the *Efficient Apartment Refrigerator* project contact John Peloza at (608)238-8276 x21, jpeloza@ecw.org.

Research Park Commissions Green Building Design

When architect Bill Sturm gave a presentation on green buildings for Chicago's South Shore Bank, and normally conservative bankers from 35 countries showed up, he realized that opportunities for energy-efficient, environmentally friendly design were on the rise.

University Research Park, a Madison-based science and technology business center and home of the Center, is part of that trend. They've recently decided to commission a design for a green building from Sturm's firm—Prisco Serena Sturm Architects, of Northbrook, Illinois.

If all goes according to plan, the Research Park will build a 30,000-square-foot office and research building sometime in 1997. The Center is participating in the design and commissioning process and will also measure the building's energy use.

Joe Danes, who manages the Center's *Green Building* project, says, "A green building should be competitive in the Madison market and offer benefits like a healthy, productive environment and less expensive energy bills."

Danes plans to host a workshop on green buildings for architects and engineers this spring. "We want to convey to the design community that this is a good, workable option," he says. "We also want to stress that this is a concerted effort between architects and engineers."

Sturm describes a number of features used in green buildings to save energy and increase occupant comfort. Tight, well-insulated walls and roofs allow architects to use a smaller and quieter heating and cooling system. Good ventilation and natural building materials improve indoor air quality, and orienting the building toward the south lets in free sunlight for lighting and heating.

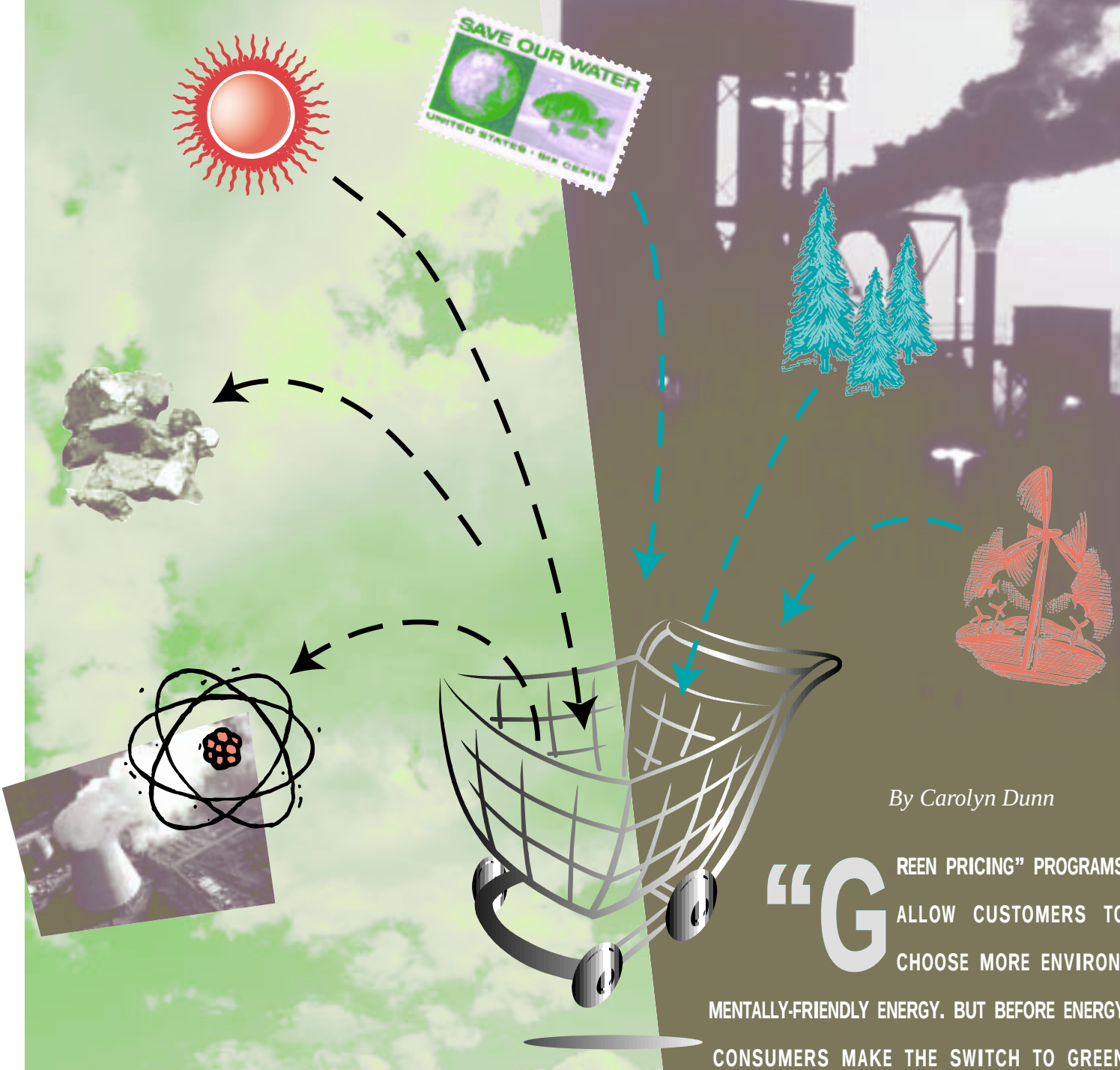
"The benefit of all this," Sturm says, "is a well-lit, quiet space that people enjoy being in."

Ed Hopkins, Associate Director-Planning for University Research Park, says the Green Building project could be a great benefit for them. "We see a green building as a socially responsible thing to do that—for a certain segment of our market—will have an appeal."

—Eric Nelson

FOR MORE INFORMATION about *green buildings* contact Joe Danes at (608)238-8276 x43, jdanes@ecw.org.

GREENER ON THE OTHER SIDE



By Carolyn Dunn

"GREEN PRICING" PROGRAMS ALLOW CUSTOMERS TO CHOOSE MORE ENVIRONMENTALLY-FRIENDLY ENERGY. BUT BEFORE ENERGY CONSUMERS MAKE THE SWITCH TO GREEN ENERGY, THEY NEED TO KNOW WHY THEY'RE PAYING MORE AND HOW MUCH GREEN THEY'RE GETTING FOR THEIR BUCK. ☛

A few months ago a natural foods store opened down the road. This large supermarket offers organic products for consumers who are willing to pay more for healthful foods that put less strain on the environment. Now many energy consumers are finding they can shop for "organic" energy through their local utility's green pricing programs. Like the health food store, green pricing programs provide an alternative product—energy from renewable resources—at a higher price.

As green pricing starts appearing in Wisconsin you may soon find yourself checking out the items in the green energy aisle. You too may want to be a smart shopper, knowing what you're buying and how it affects the environment.

GREENER THAN YOU'VE GOT

Many green customers say they are concerned with pollution and resource conservation, and collective action offers the best chance of addressing environmental problems. They are willing to pay more for something less damaging to the environment.

Through their commitment to green pricing programs, these customers tell their utility how much renewable energy to acquire—they help create the demand for renewable energy.

Green customers pay a rate premium—perhaps five to 20 percent of their normal bill—to fund the production or purchase of renewable energy. In exchange, all or part of the electricity they use is generated by renewable resources like wind or hydroelectric power.

SOLUTIONS IN THE MARKETPLACE

David Moskovitz, director of the Regulatory Assistance Project—a private thinktank serving utility regulators—says tailoring services to meet customer demand is a common practice in most markets. Green pricing brings that same focus to the utility industry. Environmental groups see green pricing as a free-market solution that can expand the demand for renewable energy.

RENEW Wisconsin director Michael Vickerman says that for him, the purpose of green pricing programs is to leverage the construction of new renewable sources. "Developing a market-based solution is the route we should take to increase the use of renewable energy. We don't have to rely on government subsidies and no laws have to be changed."

But as green pricing programs around the country are getting started, skepticism is seeping into the picture. According to Moskovitz some people are suspicious of utility motives and believe green marketing is overused. Some even question whether certain green pricing programs actually benefit the environment.

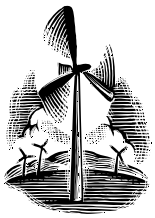
EARNING THE ORGANIC LABEL

To help assure customers that they are truly getting what they're paying for, the Public Service Commission of Wisconsin has set up criteria they use to approve green pricing programs. Because any increase in rates must be approved by the PSC, they have the final say on which green programs reach utility customers.

"We use a three-point formula," explains Paul Helgeson, a senior engineer at the PSC. "A green pricing program must (1) provide new capacity from (2) renewable resources. And (3) the program must have a way of tracking where the power comes from; we need to be sure utilities aren't selling more than they're producing."

But even PSC-approved green pricing has been controversial. Last summer Wisconsin Electric Power Company introduced a pilot program that offered green energy from biomass and hydroelectric sources at two cents per kilowatt-hour above the current rate.

When the PSC put its stamp of approval on WEPCo's pilot study in 1996, groups such as the Wisconsin Environmental Decade and RENEW voiced strong disapproval of the green pricing program. The groups claimed that some of the power wasn't green enough. As of February, 1997, the parties were still working to resolve the controversy.



KEEPING UP WITH DEMAND

One example of a successful, relatively unchallenged green pricing program is the one at Traverse City Light and Power. An 8000-customer, community utility in Michigan, TCL&P built wind turbines in the city and offered the renewable energy for 1.58 cents per kilowatt-hour above the average rate of 6.8 cents.

Over three percent of TCL&P customers wanted to participate—that's one of the highest green pricing program turnouts in the country. Demand has been so strong that TCL&P is now adding more wind capacity.

Helgeson says the fact that the small local utility is closer to its customers added credibility to the TCL&P green pricing program. He adds that the project's success can also be attributed to the wind turbine's visibility. "People can go out and see where they're buying power from."

PAYING THE PRICE FOR GREEN

At TCL&P, green customers are paying an average of $7.58 more per month for the benefit of wind energy and cleaner air. A higher-priced product might not have made it in their market, and charging too little might have kept the project grounded. Figuring out just how much people will pay for green energy is a science in and of itself.

To help prepare for entering the green pricing ring, Madison Gas & Electric Company is launching a study to gauge people's participation and establish the right price for their customers. "We're conducting a pilot study to predict participation and estimate the value that customers place on the environmental benefits of green pricing programs," says Jeff Ford, a senior analyst at MG&E.

In conjunction with the University of Wisconsin-Madison and the

Center, MG&E will use *contingent valuation* to study green pricing.

"Contingent valuation is an economic methodology used to help put a price on things that aren't true market goods—or at least aren't available in the market," explains Center executive director Mark Hanson. "We don't have a price for preserving the Grand Canyon, for example, but we could use contingent valuation to figure out *if* and *how much* people would be willing to pay for preserving this natural monument."

For MG&E's pilot study, UW researchers will break a subset of MG&E customers into two groups: those who are asked to actually participate in the green pricing program and those who are asked *whether* they would participate *if* they had the opportunity. The renewable energy for the actual MG&E green pricing program will come from wind turbines being erected near Green Bay. These customers will pay a variable surcharge for up to 100 percent of their electricity to be generated by wind.

Hanson says that by comparing the results of the actual and hypothetical offerings, the utility and researchers will get a good look at what people are willing to pay under various conditions. "With this information MG&E can enter the market more confident of customer responses to a price that is carefully set."

Ford adds that MG&E will learn what they can about the potential market in MG&E's service territory so that they can serve the market what it wants.

PRODUCT DIFFERENTIATION

In the restructured utility environment of the future, where people may be able to choose their utility, green pricing can set one utility apart from the rest. Today green pricing programs could be giving utilities a taste of what's to come, giving them a chance to test their competitive marketing skills, and making it advantageous for utilities to listen to customers about needs, pricing, and program introductions.

Ford notes that having green energy in a resource mix improves a utility's image. And for supporters of renewables, the value of green pricing lies in getting renewables into the mainstream. "These programs are demonstrations of the market appeal of renewables," Vickerman concludes.

Green pricing is still evolving in Wisconsin, but Moskovitz of the Regulatory Assistance Project explains that when properly done, green pricing has the potential to give everyone what they want: renewable supporters get increased use of renewables; utility customers get a choice; and utilities get a chance to get geared up for competition.

FOR MORE INFORMATION about green pricing contact Mark Hanson at (608)238-4601, mhanson@ecw.org.

Selected 1996/1997 Publications

Low-Income Energy Services Symposiums—Summary of Proceedings
Account of three 1996 Wisconsin symposiums *(three-volume set)*.

New Design Practices for Milking Systems—How to Cut Production Costs Through Energy Efficiency
Fact sheet for dairy farmers describing the latest energy-saving techniques and new design standards.

Estimating Wisconsin Residential Space Heating Loads
Research report describing how to estimate heating loads without costly end-use metering.

Market Assessment of New Heat Pump Technologies
Research report that examines the market in Wisconsin and elsewhere for modern heat pump technologies.

Tracking the HVAC Market for Energy Efficiency Services
Research report establishing baseline practices of HVAC contractors in Wisconsin.

Tracking the Building Market for Energy Efficiency Services
This report establishes baseline energy-efficiency practices of building contractors in Wisconsin.

Tracking the Insulation Market for Energy Efficiency Services
This report establishes baseline energy-efficiency practices of insulation contractors in Wisconsin.

Appliance Sales Tracking—1995 Residential Survey
Report documenting an ongoing study of efficiency trends in residential appliances.

Process Energy Efficiency Improvement in Wisconsin Cheese Plants
Master's thesis from the UW-Madison Department of Mechanical Engineering.

A Conceptual Guide to K-12 Energy Education in Wisconsin
Conceptual framework and suggested scope and sequence for energy education.

FOR MORE INFORMATION, or to place an order, contact Heather Elmeer at (608) 238-8276 x10, helmeer@ecw.org.

energy

sun burns
earth warms
grows ferns
coal forms

flame quakes
steam blows
energy wakes
home glows

— b, c & e

CALENDAR OF EVENTS

April 20-25
Affordable Comfort 97
Chicago, IL

FOR MORE INFORMATION about this forum on building science contact the Affordable Comfort office at 1-800-344-4866.

May 28
A Grand New Energy Conference
Milwaukee, WI

FOR MORE INFORMATION on this event for Wisconsin middle school students, contact Kathy Kuntz at (608)238-8276 x24, kkuntz@ecw.org.

Center Workshops

FOR MORE INFORMATION about the following Energy Center of Wisconsin workshops contact Marge Anderson at (608)238-8276 x32, manderson@ecw.org.

March 19
RPM's MotorMaster Plus Training
Wausau, WI

April 3
1997 Geothermal Heating and Cooling Teleconference: Innovative Solutions for the Residential Building Industry
Madison, WI

April 21
RPM's MotorMaster Plus Training
Superior, WI

April 22
RPM's MotorMaster Plus Training
La Crosse, WI

April 29-30
Energy Conservation & HVAC Code (Chapters 63-64) Training
Milwaukee, WI (SOLD OUT)

May 1
Governor's Business Roundtable on Energy and the Environment
Pewaukee, WI

May 7-8
Energy Conservation & HVAC Code (Chapters 63-64) Training
Wausau, WI

May 13-14
Energy Conservation & HVAC Code (Chapters 63-64) Training
Appleton, WI

May 20-21
Energy Conservation & HVAC Code (Chapters 63-64) Training
Madison, WI

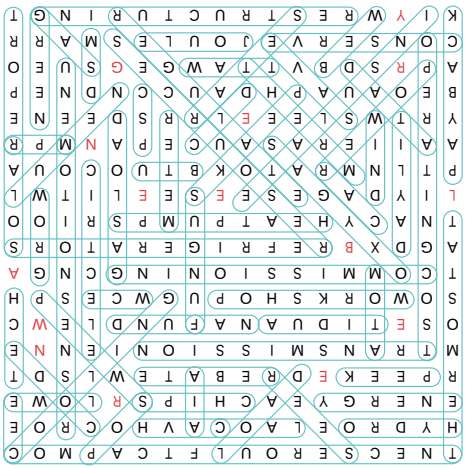
June 25-26
The Road to Efficiency–Optimizing Your Motor Systems
Green Bay, WI

ENERGY JARGON

Solution
from page 13

r e n e w a b l e

e n e r g y



E² Science

Motors of Magnesia

The story of motors begins with strange attracting rocks found in Magnesia, an ancient city in Asia Minor. Later called magnets, these stones held the power that drives today's industrial machines.

In the 19th century a scientist named Oersted discovered that if you pass electricity through a wire, you can make a magnet. Another fellow, Faraday, soon discovered the opposite: if you move a magnet around, you can generate electricity. Motors, which are essentially a magnet within a magnet, exploit these principles to create rotation.

As the Motor Turns

A motor consists of a *rotor*—a stack of steel discs mounted on an axle—which turns within a *stator*—a stack of notched washers wound in loops of bundled wire called *windings*. The stator is magnetized by passing electricity through the windings.

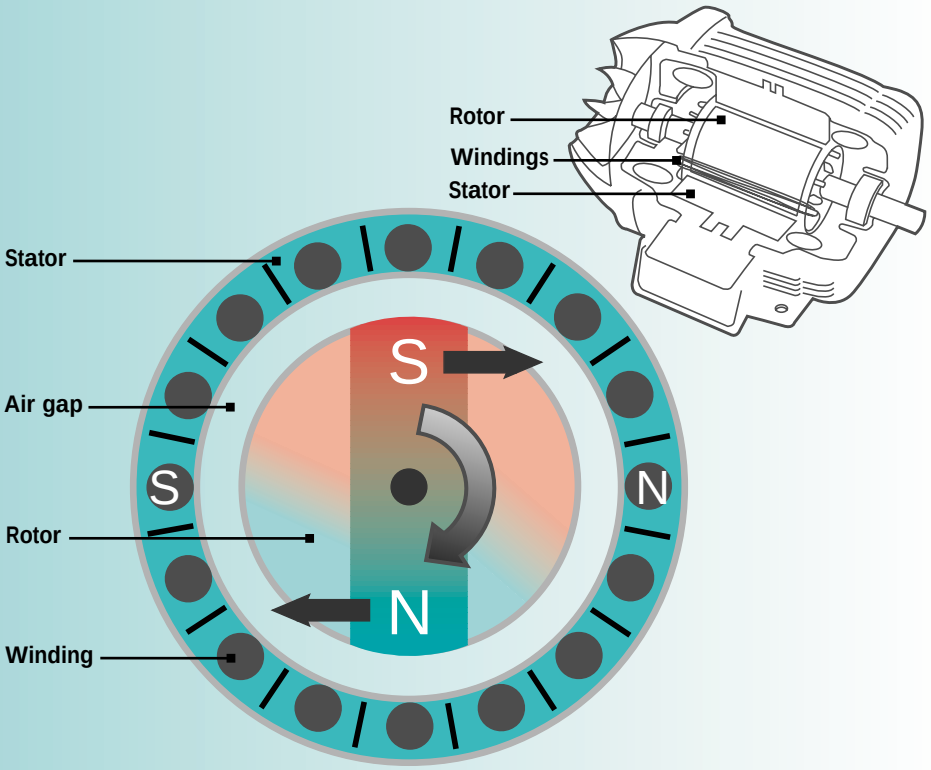
Windings are electrified sequentially, and this causes the stator's magnetic field to move in a circle. This "moving magnet" indirectly creates a current in the rotor, magnetizing it in the process.

The stator and rotor now have magnetic *poles*. The stator's north pole attracts the rotor's south pole, causing a torque, or twisting motion, in the rotor. To maintain the torque, the stator magnet is made to stay one step ahead of the rotor magnet, forcing the rotor to play a never-ending game of magnetic catch-up. The result is rotation.

Efficiency Matters

A perfectly efficient motor would convert 100 percent of its electricity into rotation. In practice, however, a motor loses energy in several ways—losses that a high-efficiency motor minimizes.

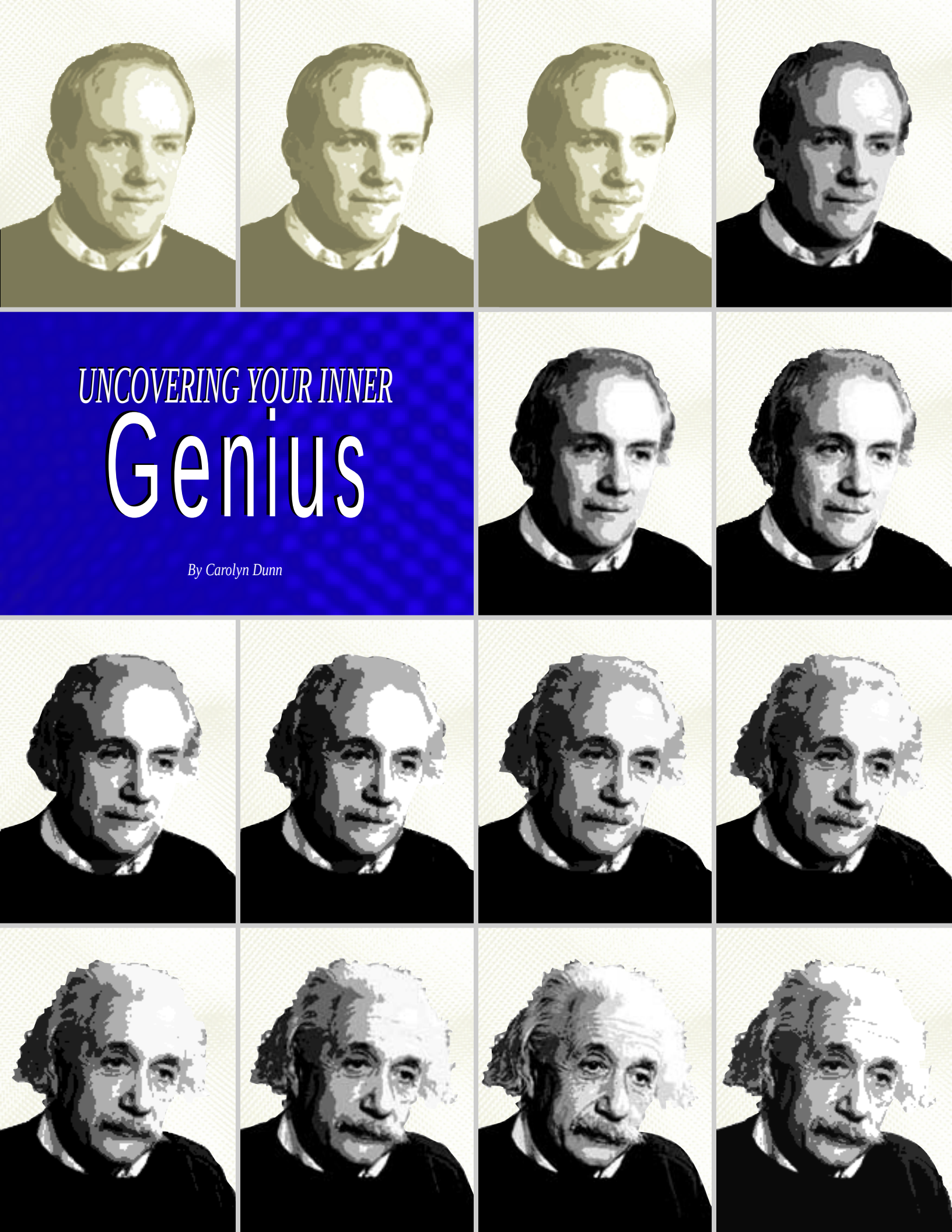
- **Electrical resistance.** Copper in the windings resists the electric current. Better copper and thicker wire reduces resistance and the resulting heat buildup, which also allows a smaller fan to be used.



- **Magnetic resistance.** Similar to electrical resistance, magnetic resistance leads to energy losses and heat. The solution: better steel.
- **Friction.** Axle friction and air resistance put drag on the rotor, but improved bearings and fans minimize these losses.
- **Stray losses.** Improvements such as setting the right size air gap between stator and rotor reduce these electrical and magnetic leaks.

What all this good design leads to is motors that last longer and use two to six percent less energy than standard-efficiency motors. The Center's *Responsible Power Management* program is spreading the news about these motors to industry.

—Eric Nelson



UNCOVERING YOUR INNER Genius

By Carolyn Dunn

The real difficulty, the difficulty which has baffled the sages of all times, is rather this: How can we make our teaching so potent in the motional life of man, that its influence should withstand the pressure of the elemental psychic forces in the individual?

Albert Einstein

In 1995 one new piece of technology came into our universe every 15 minutes. By the year 2000 we will be bombarded with a new technology every 15 seconds. Keeping up with all the changes is enough to make your head spin, especially in the energy industry.

As work time becomes more and more precious, how the average person learns about advances in the industry becomes very important. Busy professionals need to learn about advances in their field—fast. In response, many trainers in the energy industry have picked up the pace with a new way of teaching: *accelerated learning.*

"Intelligence makes clear to us the interrelationship of means and ends."

Accelerated learning is a relatively new approach to learning that respects the fact that different people learn differently. At the core of this effort to make it easier for learners to absorb new information are what Dr. Howard Gardner termed the "seven intelligences" (see page 30). These seven intelligences—linguistic, logic/math, musical, visual/spatial, kinesthetic, interpersonal, and introspective—allow people to experience classroom training the same way they take in the world around them, through their natural senses.

"The multiple intelligences cover all the different ways people take in information—there's a piece of each of these intelligences in all of us," explains Marge Anderson, the Center's education program manager. "But some people might learn better when information is filtered through one or two of them."

For example, a learner might better understand the design of an energy-efficient technology by building a small-scale model—learning kinesthetically. That same person could also comprehend more about the technology through talking with others—interpersonal learning. Anderson emphasizes that because each person's ability to learn is made up of all seven intelligences, trainers need to involve the whole person—all intelligences—in the learning experience.

At Center workshops, Anderson has begun incorporating the seven intelligences into her training courses. Center education programs are now accented with more music, more color, more toys and exercises, all helping to make sure the audience is the focus of what's happening. This is good news for the kinesthetic learner, the musical learner, and the visual learner: those for whom standard lecture—linguistic learning—isn't the primary means of learning.

"It is the supreme art of the teacher to awaken joy in creative expression and knowledge."

Accelerated learning also takes into account the fact that we all learn from each other. In traditional training, the only path of learning that often happens is between the presenter and the audience. With interactive learning, everyone is part teacher and part learner; and there are learning paths going back and forth between everyone.

Jeanne Ludjack, owner of Dimensional Learning Systems, works with many technical companies to help them incorporate accelerated learning principles into their training. She sees the trainer simply as a facilitator of learning. "Each participant brings a wealth of knowledge to the classroom. It's the job of the trainer to draw out that knowledge," she says. "Accelerated learning gets away from teacher as expert and learner as apprentice, and recognizes that the student has a lot to offer."

Ludjack has been involved in revamping some of the Center's most technical training on creating efficient motor systems in large industrial facilities. In the past, the course was made up completely of straight lecture. Ludjack notes that the training was only addressing one learning style, and this time around she wants to ensure that all the participants receive the message. She's helping design the new training so that it reaches participants of every learning style and promotes interaction between learners.

Each module is 45 to 60 minutes long and formatted with accelerated learning. Ludjack explains the new design allows for cooperative learning, leaves time for review, and makes sure that each presentation is a mix of

slides and lecture, models, posters, and group problem-solving and brainstorming. "We're making sure participants are learning a bit through each of their intelligences."

"Only one who devotes himself to a cause with his whole strength and soul can be a true master. For this reason mastery demands all of a person."

Studies by the Boulder Center of Accelerative Learning show that accelerated learning results in participants learning more in less time, retaining more information, and scoring higher on tests.

According to BCAL most people leave traditional training and within a matter of days, the information they heard may decay rapidly from their memory to a mere 10 percent of what was originally taught. When accelerated learning makes learning an active and creative process, even if participants don't review the material, they're able to retain 40 percent of the original material. "When you're having fun, you learn more," Anderson adds. "When you're unhappy, learning is depressed."

Accelerated learning encourages participants to reinforce learned material as soon as possible after the learning activity. "At our workshops, we give participants a review schedule," says Anderson. "If they follow it, they can retain 90 percent of the information. But it's the learner's responsibility. I see it as they've invested their day, they may as well take the extra steps to make the information stick."

"Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world."

Although accelerated learning may open up a whole new world of learning for many people, this approach might be asking many others to step outside of their comfort zones. "When you've gone to training in the past you're expected to sit still and listen for maybe seven or eight full hours," says Anderson. "It can be a little shocking to come to a training that uses accelerated learning and find a Nerf ball on your table or hear reggae music playing in the background."

The keys of accelerated learning ask learners to shift their paradigms, break through self-limiting beliefs, and move through fear. Although accelerated learning may take some people out of their comfort zone, others have been outside their zones in traditional lecture. Anderson says accelerated learning captures more people by offering a wider variety of learning stimuli.

Pat Seidel, a training account manager at Wisconsin Power & Light Company is careful how far she goes with accelerated learning novices. "It's a culture shift for many. In my early initiatives I have to be careful not to turn people off." Seidel gets around resistance by subtly introducing a stimulus, like a Nerf ball.

"At break, people mill around the toy table and soon I see they're involved in an active game of catch. They're stimulating the physical part of their learning, and realize there's something a little different going on, but are still working within their comfort zones."

"The only source of knowledge is experience."

For Anderson, her accelerated learning vision is this: "When you leave a Center workshop you should be inspired, energized, and motivated to create something in your organization with what you've learned there." She says she knows her programs can get there with accelerated learning.

And at WP&L, Seidel says she's mostly looking to get people comfortable with accelerated learning. But her idealism still comes through. "In the perfect world, I'd have the time to overlay the complete accelerated learning system onto all the training I do and make sure that every intelligence is touched on every 50 minutes."

FOR MORE INFORMATION about accelerated learning and Center workshops contact Marge Anderson at (608)238-8276 x32, manderson@ecw.org.

DR. HOWARD GARDNER'S SEVEN INTELLIGENCES

LINGUISTIC = LANGUAGE

Lecture, written handouts, visuals with words.

LOGIC/MATH = EQUATIONS, NUMBERS, SEQUENCED EVENTS, STATISTICS

Problems to solve, step-by-step presentation of material, presentation of numerical data.

MUSICAL = MUSIC, RHYTHM

Music at breaks, rhythmic mnemonics exercises, rhyme.

VISUAL/SPACIAL = PICTURES, ICONS, METAPHORS

Graphs and charts, visuals with pictures, guided imagery, metaphor and allegory, videos, flip charts, slides, overheads, color.

KINESTHETIC = PHYSICAL MOVEMENT, EMOTIONS

Making a personal/emotional connection between material and participants, physical exercise, hands-on demonstration work, working models, construction/ model-making activities.

INTERPERSONAL = COOPERATIVE LEARNING, PEOPLE INTERACTING

Small-group work, questions and answers, roundtables, working in teams or pairs.

INTROSPECTIVE = SELF REFLECTION

Reflective writing, action plans, personal next steps, relating material to personal experience.

NEWS

Inexpensive, but Not Inefficient

As the temperature began dropping last fall, volunteers put the finishing touches on the *Affordable New Home* project in Milwaukee. Nearly 50 people came together to landscape at the new energy-efficient house that is home to a woman and her three children. Unlike other affordable housing programs that concentrate on the purchase price of the home, this project—sponsored by the Center, the Carpenters' Home Improvement Program, Inc., and a Milwaukee-area architect—turned to energy efficiency as a way to make sure people can also afford to heat their homes. This house uses a new type of insulated outer wall, called a stressed skin panel, as well as other high-efficiency technologies like air-to-air heat exchangers. The family moved into their new home just in time for the holidays.

—Carolyn Dunn

FOR MORE INFORMATION about the *Affordable New Home* project contact Craig Schepp at (608)238-8276 x16, cschepp@ecw.org.

Energy-Efficient Home Building: Premiering on a VCR Near You

Someone building a new home could save 15 percent on their heating costs by pointing it toward the south. But a builder might not know this, and the consumer might be the person to tell them.

To educate consumers about building an energy-efficient Wisconsin home, the Center has created a three-part video series called *Energy Efficient Home Building*.

Each video is 30 minutes long, covering design, construction, and appliances. Part I, *Planning and Design*, looks at site orientation, landscaping, dealing with architects, and selecting a builder. Part II, *The Construction Process*, focuses on insulation products and techniques. Part III, *Energy Efficient Components*, examines ventilation, furnaces, air conditioners, lighting, and appliances.

"There are a lot of energy-efficient measures that people don't know they could ask for," says Center project manager Joe Danes. "The main goal of this project is to get people to go up to a designer or builder and ask for those things. This will help generate demand for energy-efficient homes in the marketplace."

The Center and several Wisconsin utilities plan to promote the videos, which are also being donated to state public libraries.

—Eric Nelson

FOR MORE INFORMATION about the *Energy Efficient Home Building* videos contact Joe Danes at (608)238-8276 x43, jdanes@ecw.org.

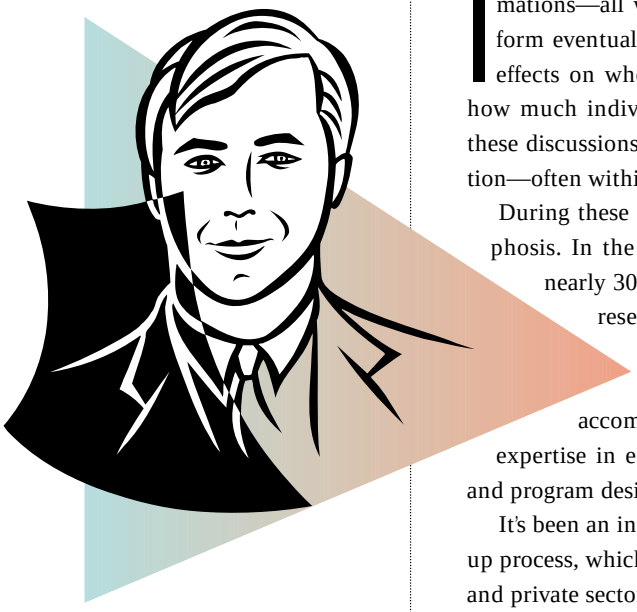
North Shore Water Commission Reduces Thirst for Electricity

Each day North Shore Water Commission distributes about 4.7 million gallons of potable water to three Milwaukee-area communities. Even though the systems that provide this water were keeping up with demand, North Shore's manager Roger Johnson recognized that there was room for improvement. Johnson asked the Center to help him study his pumping and distribution systems.

A preliminary study showed that by reconfiguring pump operating sequence, lowering the water distribution system pressure, and improving controls, North Shore would be able to increase pumping capacity and efficiency. The Center estimates that the system changes could save North Shore at least $19,600 each year in energy costs—that's 385,000 kilowatt-hours per year. They could also see a reduction in pump and system maintenance, a decrease in water loss and broken water mains, and improved system operation. North Shore plans to make adjustments to its systems sometime in 1997.

—Carolyn Dunn

FOR MORE INFORMATION about industrial performance optimization contact Ron Wroblewski at (608)238-8276 x25, rwroblewski@ecw.org.



It seems like every day I hear more about transitions, modifications, and transformations—all words that indicate change. Utility deregulation, regardless of what form eventually emerges from today's discussions, will have profound and lasting effects on who provides energy and related services, how energy is viewed, and how much individuals and society pay for energy. As a witness and participant in these discussions, my emotions can't help but range between excitement and trepidation—often within the same afternoon!

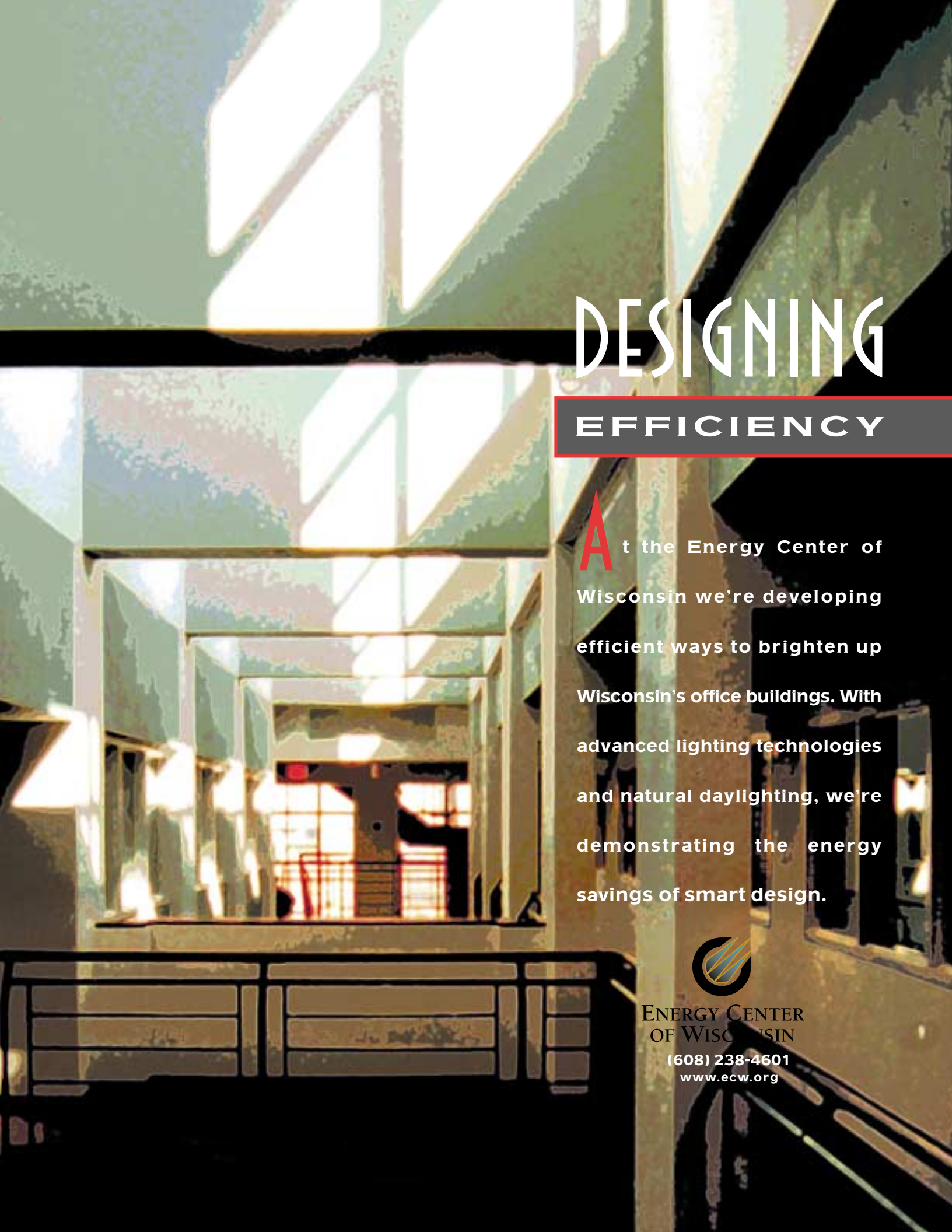
During these first seven years of the Center's existence I've witnessed a metamorphosis. In the beginning I was part of a staff of three, and now we've grown to nearly 30 professionals and several on-site student interns. From a handful of research projects our activities have broadened to include a balanced contingent of continuing education, demonstration programs, and residential, commercial, and industrial research projects. To accommodate this expansion we've cultivated our staff to include broad expertise in engineering, energy policy, education, publications, library services, and program design, delivery, and evaluation.

It's been an interesting and rewarding experience for me to be part of this growing-up process, which has created productive relationships with many others in the public and private sectors. I'm amazed at the response we've received from organizations that we haven't dealt with previously as they become acquainted with what the Center has to offer as both a source of information and a forum to exchange ideas.

One of our more important relationships is with the University of Wisconsin-Madison, one of our founding groups. Historically our interaction has been limited to the Institute for Environmental Studies, the Department of Urban and Regional Planning, the Wisconsin Public Utility Institute, and the College of Engineering. Of late, our ties have been strengthened with the formation of the Energy Services Education and Research Committee, which is drawing interest from other sectors such as the School of Business and the Department of Agricultural Engineering. As a graduate of the University of Wisconsin myself, I'm gratified to see our interaction with the university system continue to grow.

The changes brought about by utility deregulation will mean opportunity for those who can identify them as such, and they'll place a premium on adaptability. I believe maintaining strong but flexible relationships at every level—from individual residential utility customers to the federal government—will be critical to the Center's evolution. These pathways to exchange information are a key to more efficient energy use now and in the future. I look for our role to continue to be redefined for the benefit of all as our energy future unfolds.

Rich Hackner
Associate Director



DESIGNING EFFICIENCY

At the Energy Center of Wisconsin we're developing efficient ways to brighten up Wisconsin's office buildings. With advanced lighting technologies and natural daylighting, we're demonstrating the energy savings of smart design.

ENERGY CENTER OF WISCONSIN
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